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Validation of SMOS Soil Moisture over SCAN/SNOTEL Network

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Since its launch, ESA's Soil Moisture and Ocean Salinity (SMOS) satellite, is delivering unique data from its L-Band 1.4Ghz 2D interferometer. The multi-angular brightness temperatures from SMOS are used to retrieve soil moisture in the first centimeters of the soil and ocean salinity at the surface of the water. The SMOS data has a temporal resolution 3 days or finer, and a nominal spatial resolution of 43km.

We present the validation of the SMOS soil moisture data over the continental US (CONUS). SMOS brightness temperatures products (level1C) and soil moisture products (level2SM) are retrieved for a one year period from January 2010 to January 2011. Initially, different processor configurations and versions were used to produce the soil moisture retrievals. Re-processed brightness temperatures (L1C), with uniform configurations and calibrations, were recently extracted for the period. With these data , soil moisture is retrieved using ESA's soil moisture operational prototype (SML2OP) with various processing configurations. Surface characteristics and changes are taken into consideration in the analyses and linked to processing configurations. Inversion performances are extracted from the data analysis products at level 2.

Data over lying the Soil Climate Analysis Network (SCAN) sites and the SNOwpack TELemetry (SNOTEL) sites are extracted. The SCAN and SNOTEL networks are provided from the National Soil Survey Center of the USDA. They give access to valuable data over many climatic stations across CONUS. Only stations equipped with soil temperature at 2-in or soil moisture at 2-in sensors are considered. Hourly data is downloaded for 2010 and directly used for the comparison. Due to SMOS resolution direct comparison between the site data and the SMOS nodes is questionable. Limits due to issues of spatial scale that challenge the validity of direct comparison are shown and alternative methods are presented.

The direct comparison shows that SMOS data compares well to the SCAN/SNOTEL network globally. We compute statistics and quality indexes. We try to link the underestimation of soil moisture from SMOS to different parameters and processing configurations. The effect of fraction of cover (bare soil, forest) on the quality of fit is discussed. The results show that the effect of topography is less than expected. One can expect that higher coverage rates can be considered if the topographic index threshold is reduced. Results also show that SMOS is sensitive to soil moisture under forest cover. Soil moisture over these surfaces shows good dynamics up to a certain value of vegetation density. Effect of climatic events like freezing and thawing are also shown.

We expect that the validation efforts over SCAN/SNOTEL sites will contribute to efforts to quantify the uncertainty and error associated with the SMOS data. This information is a crucial input for the future land assimilation system under development.